

A Theoretical, Practical, Predictive Model of Faculty and Department Research Productivity

Carole J. Bland, PhD, Bruce A. Center, PhD, Deborah A. Finstad, Kelly R. Risbey, MEd, and Justin G. Staples, MA

Abstract

Purpose

Although numerous characteristics impact faculty research productivity, and although researchers have suggested comprehensive theoretical models to explain the relationship between these characteristics and levels of faculty research productivity, few studies have assessed these models. This study tests the ability of the Bland et al. (2002) model—based on individual, institutional, and leadership variables influencing faculty research productivity—to explain individual and group (department) research productivity within the context of a large medical school.

Method

This study used data from a University of Minnesota Medical School—Twin Cities vitality survey conducted in 2000 that had a response rate of 76% ($n = 465$ faculty). A statistical software package was used to conduct t tests, logistic regressions, and multiple regressions on these data.

Results

The validity of faculty, department, and leadership characteristics identified in the Bland et al. (2002) model were confirmed as necessary for high levels of research productivity. Faculty productivity was influenced more by individual and institutional characteristics; group pro-

ductivity was more affected by institutional and leadership characteristics.

Conclusion

The characteristics and groupings (individual, institutional, and leadership) in the Bland et al. (2002) model predict faculty research productivity. Research productivity is influenced by the interaction of the three broad groupings, and it is the dynamic interplay of individual and institutional characteristics, supplemented with effective leadership, that determines the productivity of individuals and departments.

Acad Med. 2005; 80:225–237.

The purpose for this study was to understand better how to facilitate faculty research productivity in an established research university. Growing external pressures have forced universities and colleges to ask faculty to continually increase their levels of productivity with the same or fewer resources. These pressures include decreased revenues and funding along with calls from government for

greater outcome-based accountability, increasing pressure from industry for market-driven innovations, burgeoning competition for domestic and international students, growing diversity in online and distance education, and mounting societal demands for higher education to cultivate both significant research advances and a liberally-educated citizenry.

It is in this larger context that the University of Minnesota Medical School—Twin Cities, wishing to facilitate the vitality and productivity of its 615 full-time faculty members, conducted an assessment of the faculty, institution, and leadership characteristics associated with high levels of research productivity among faculty. The purposes of the assessment were to (1) identify individual, institutional, and leadership areas in which the medical school was strong, and ones in which it needed improvement; (2) identify strategies for addressing weak areas; and (3) provide a baseline against which to measure the impact of any efforts initiated to increase faculty vitality and productivity. The results of this assessment and the use of its information to facilitate faculty vitality are reported elsewhere.¹ This report

uses the assessment data to further our understanding about the specific characteristics that facilitated faculty research productivity.

Contributions and Research Questions of the Present Study

The factors influencing faculty research productivity have been studied for decades. Most of these studies, from which general models of research productivity are derived, have used cross-sectional designs that investigate the impact of likely features that facilitate research among faculty across different institutions. Other studies typically investigate the impact of only a few features suspected of influencing faculty research productivity. Based on a synthesis of this literature, scholars have proposed models of how these characteristics work together, although few studies have been able to test these models. They have not been able to assess the combined impact of features by studying all the features at one time in one institution.

Therefore, we investigated how the multiple characteristics thought to facilitate faculty research productivity simulta-

Dr. Bland is professor and director of the Department of Family Medicine and Community Health's Research Program, University of Minnesota Medical School, Minneapolis, Minnesota.

Dr. Center is research associate and assistant professor, University of Minnesota Medical School, Minneapolis, Minnesota.

Ms. Finstad is information technology supervisor, University of Minnesota Medical School, Minneapolis, Minnesota.

Ms. Risbey is research assistant, Department of Educational Policy and Administration, University of Minnesota, Minneapolis, Minnesota.

Mr. Staples is with Human Capital, Deloitte, Atlanta, Georgia.

Correspondence should be addressed to Dr. Bland, University of Minnesota Medical School, Department of Family Medicine and Community Health, MMC 381, 420 Delaware Street S.E., Minneapolis, MN 55455-0392; telephone: 612-624-2072; fax: 612-625-0640; e-mail: (bland001@umn.edu).

neously affect faculty productivity and assessed the validity of a theoretical model that has been utilized in, and developed by, numerous studies (e.g., Bland and Schmitz, 1986; Bland and Ruffin, 1992; Bland and Bergquist, 1997; Bland, Weber-Main, Lund, and Finstad, 2004).²⁻⁵ This model will subsequently be referred to as the Bland et al. (2002) model of faculty research productivity. Specifically, this study addressed five questions:

1. What individual, institutional (college and department level), and leadership variables best predict an individual faculty member's research productivity?
2. What variables best predict group (department) research productivity?
3. What variables best predict a faculty member's satisfaction, as measured by a willingness to choose the same organization again (department, school, or university)?
4. How well does the Bland et al. (2002) model explain faculty research productivity?
5. How is this information practically applied to facilitate an individual's or a group's research productivity?

Towards a Model of Faculty Research Productivity

Numerous studies on faculty research productivity identify a consistent set of facilitating characteristics that have an impact on faculty research productivity. A few authors⁶⁻¹⁰ have grouped these characteristics into clusters or models to understand the major factors that affect research productivity and to begin to identify a model that explains faculty research productivity. The Bland et al. (2002) model we used in this study builds on these earlier models, as is illustrated by the following discussion of earlier attempts to cluster disparate characteristics into explanatory models.

Finkelstein⁶ suggested that seven critical variables predict faculty publication rates: faculty researchers having a research orientation, the highest terminal degree within a field, early publication habits, previous publication activity, communication with disciplinary colleagues, subscriptions to a large number of journals, and sufficient time allocated to research. Finkelstein's early model of research productivity is useful because it provides an initial picture of the attributes of a successful researcher at the individual faculty level. However, Finkelstein's model does

not clearly articulate the institutional factors that affect faculty research productivity.

Creswell's⁷ model begins to account for some institutional factors affecting faculty research productivity. He described successful researchers as those who tend to hold a senior professorial rank, spend at least one-third of their time on research activities, publish early in their careers, receive positive feedback from peers for research efforts, and maintain regular and close contact with colleagues on and off campus who conduct research on similar topics. Creswell's model extends beyond individual characteristics by acknowledging that faculty researchers are more productive when they are employed by a major university that rewards research and assigns ample time for faculty to conduct research. Thus, Creswell's model acknowledges the importance of the institution and the research culture within that institution on an individual faculty's research productivity.

Dundar and Lewis⁸ proposed a model in which faculty research productivity is primarily associated with two attributes: individual attributes that relate to personal traits and environmental experiences and institutional and departmental attributes that entail variables related to leadership, culture, structure, and policies. Based on a study of more than 3,600 research-doctoral programs in the United States, they found that one of the most significant predictors of faculty research productivity is faculty-group size. Other features included such things as being a private rather than a public institution, having a larger number of full professors, and having a larger percentage of faculty within a department actively publishing in peer-reviewed journals.

Teodorescu⁹ proposed an international model of faculty research publication productivity. Teodorescu's model asserted that individual achievement variables and institutional characteristic variables would predict faculty research productivity across national boundaries. In a test of this model across ten nations, Teodorescu found that, although correlates of faculty research productivity varied across national boundaries, faculty involvement in disciplinary affiliations (such as membership in professional societies and attendance at professional conferences) was significantly related to research productivity across all countries.

A fifth model by Brocato¹⁰ proposed that faculty research productivity in the context of medical school family practice departments is related primarily to the broad factors of early research socialization, individual faculty's psychological and demographic characteristics, and the institutional and departmental research environments. He found that individual faculty's characteristics, such as motivation, professional networks, and research training, were highly correlated to research productivity. He also determined that institutional, departmental, and disciplinary characteristics had a much lower impact on faculty research productivity, especially in relation to the individual faculty's characteristics.

Bland and colleagues synthesized the literature on faculty research productivity into a model that asserts high research productivity is strongly associated with eight individual characteristics, fifteen institutional characteristics, and four leadership characteristics. This model has evolved through its application in several studies, as noted earlier. In the Bland et al. (2002) model, faculty research productivity is highest when a faculty member has specific individual qualities, works in an institution that is highly conducive to research, and is led by someone who possesses essential leadership qualities and uses an assertive-participatory management approach. Figure 1 displays the model and List 1 briefly describes the individual, institutional, and leadership characteristics in the model.

Further, the Bland et al. (2002) model suggests a hierarchical order to these three sets of qualities. That is, the individual characteristics are essential, but they have more or less power in assuring faculty research productivity depending on how research-conducive the faculty member's institution is. Finally, the impact of the institution is mediated by the qualities and style of the leader.

Many of the individual-level characteristics and institution-wide features that facilitate faculty research productivity are already present in most established research-oriented universities. For example, in such institutions research is consistently emphasized in the mission and the promotion and tenure structure. Also, most faculty in these institutions have individual characteristics, such as holding the highest terminal degree in

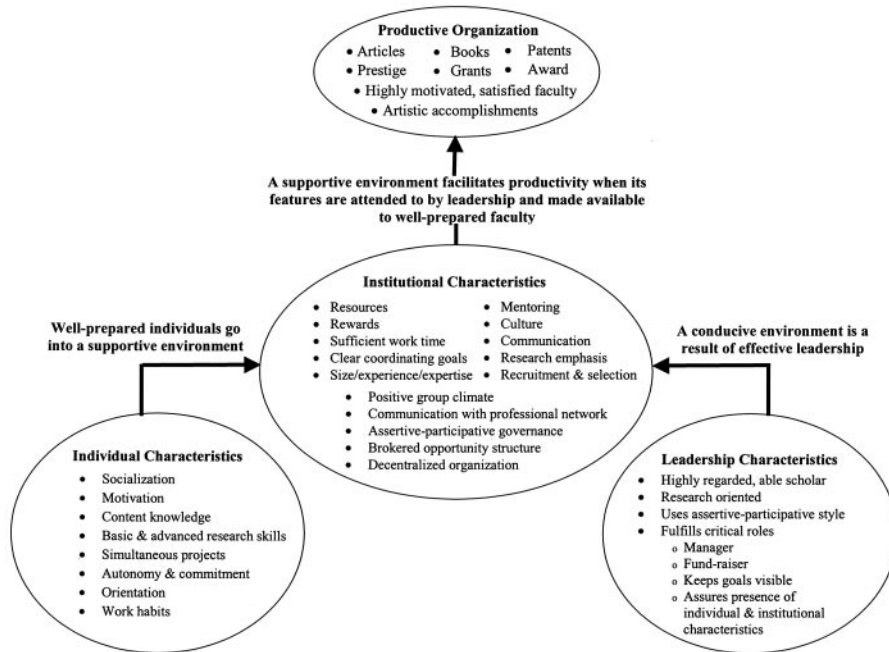


Figure 1 Components of productive research organization: the individual, environmental, and leadership characteristics that prior literature has found to be associated with high academic productivity. For optimal productivity, *all* features in each component must be present and accessible.

their field, being tenured, and holding the highest rank. In addition, these faculty have most of the other individual characteristics of a productive researcher, such as being driven to do research, socialized to the research culture, and well grounded in basic content knowledge and research skills. So, although the above-cited literature is useful to institutions such as these, it is not specific enough to inform decisions about what would further facilitate the faculty’s research productivity.

Statement of Purpose

The Bland et al. (2002) model addresses this inadequacy by applying a hierarchical dimension to the variables affecting faculty research productivity. Thus, using the Bland et al. (2002) model, we conducted this study to identify and confirm the broad range of characteristics associated with faculty research productivity within a single college in a research-oriented university.

Method

Questionnaire

As described above, the data used in this study came from a survey of 615 full-time faculty at the University of Minnesota Medical School—Twin Cities. A subcom-

mittee of the school’s faculty senate developed the questionnaire. Items were designed to assess all the characteristics in Figure 1 at the college and department levels. The questionnaire also included items on the faculty’s background (e.g., degree, rank) and workload and productivity (e.g., time committed to various tasks, articles published). When possible, items were drawn from other questionnaires, such as one designed by Brocato¹⁰ while he was at the Medical College of Ohio and a questionnaire by the National Center for Education Statistics, U.S. Department of Education.¹¹ Four specialists in faculty development were asked to assess the content validity of the items. The questionnaire was revised until it was the consensus of these experts that each item matched its intended content.

The questionnaire was then pilot tested to assure clarity and ease of completion. The final questionnaire had 56 primary questions, many with subquestions, resulting in about 150 items. With a few exceptions, the items were rated on a five-point scale with 1 = “Strongly disagree” and 5 = “Strongly agree.” For some items, respondents had the option to indicate “Don’t know” or “Not applicable.” Each question corresponded to one of the three Bland et al. (2002) model clusters: individual, institutional, or lead-

ership characteristics. Some questions, however, inherently measured more than one characteristic. For example, a question regarding the amount of time a faculty member spent on research could relate to both individual characteristics (“I choose to spend this amount of time on research”) and institutional characteristics (“The institution allows me to spend this much time on research”). These questions were ultimately linked to only one cluster by determining the primary emphasis of the question and how it related to the theoretical clusters determined in the Bland et al. (2002) model.

Survey administration, respondents, and analysis

The questionnaire was mailed in May of 2000 to all 615 full-time (those working more than 66% FTEs [full-time equivalents]) faculty, and, after several reminders, 465 were returned, resulting in a response rate of 76%. The respondents were no different from nonrespondents on demographic characteristics. On quantitative data, SPSS was used to perform *t* tests, logistic regressions, and multiple regressions. The University of Minnesota Institutional Review Board approved the use of these data for this study.

Results and Discussion

Demographics

Of the 465 faculty who provided data, 74% were men, 45% had a high level of productivity (i.e., published five or more peer-reviewed articles in the past two years), 57% were younger than 50, and 82% held either an MD or PhD. In addition, 79% of the respondents were from clinical departments, as compared with basic sciences departments (21%); 87% were white; 99% were assistant professors or higher; and 84% were tenured or on the tenure track.

Three demographic variables in this survey were *not* significant predictors of faculty research productivity:

1. **Age.** There was no difference in faculty research productivity due to age. This finding is consistent with most of the studies investigating age and research productivity that find no association.¹²
2. **Gender.** Previous studies have concluded that male faculty tend to publish more than female faculty.^{7,13,14} At first glance, we found male faculty published

List 1

Description of Individual, Institutional, and Leadership Characteristics That Facilitate Research Productivity

Individual	Institutional	Leadership
<p>1. Socialization: Understands the values, norms, expectations, and sanctions affecting established faculty (e.g., beneficence, academic freedom).</p> <p>2. Motivation: Driven to explore, understand, and follow one’s own ideas, and to advance and contribute to society through innovation, discovery, and creative works.</p> <p>3. Content knowledge: Familiar—within one’s research area—with all major published works, projects being conducted, differing theories, key researchers, and predominant funding sources.</p> <p>4. Basic and advanced research skills: Comfortable with statistics, study design, data collection methods, and advanced methods commonly used in one’s area.</p> <p>5. Simultaneous projects: Engaged in multiple, concurrent projects, so as to buffer against disillusionment if one project stalls or fails.</p> <p>6. Orientation: Committed to both external activities (e.g., regional and national meetings, collaborating with colleagues) and activities within one’s own organization (e.g., curriculum planning, institutional governance).</p> <p>7. Autonomy and commitment: Has academic freedom, plans one’s own time and sets one’s own goals, but is also committed to and plays a meaningful role within the larger organization.</p> <p>8. Work habits: Has established productive scholarly habits early on in one’s career.</p>	<p>1. Recruitment and selection: Great effort is expended to recruit and hire members who have the training, goals, commitment, and socialization that match the institution.</p> <p>2. Clear coordinating goals: Visible, shared goals coordinate members’ work.</p> <p>3. Research emphasis: Research has greater or equal priority than other goals.</p> <p>4. Culture: Members are bonded by shared, research-related values and practices, have a safe home for testing new ideas.</p> <p>5. Positive group climate: The climate is characterized by high morale, a spirit of innovation, dedication to work, receptivity to new ideas, frequent interactions, high degree of cooperation, low member turnover, good leader/member relationships, and open discussion of disagreements.</p> <p>6. Mentoring: Beginning and midlevel members are assisted by and collaborate with established scholars.</p> <p>7. Communication with professional network: Members have a vibrant network of colleagues with whom they have frequent and substantive (not merely social) research communication, both impromptu and formal, in and outside of the institution.</p> <p>8. Resources: Members have access to sufficient resources such as funding, facilities, and especially humans (e.g., local peers for support, research assistants, technical consultants).</p> <p>9. Sufficient work time: Members have significant periods of uninterrupted time to devote to scholarly activities.</p> <p>10. Size/experience/expertise: Members offer different perspectives by virtue of differences in their degree levels, approaches to problems, and varying discipline backgrounds; the group is stable, and its size is at or above a “critical mass.”</p> <p>11. Communication: Clear and multiple forms of communication such that all members feel informed.</p> <p>12. Rewards: Research is rewarded equitably and in accordance with defined benchmarks of achievement; potential rewards include money, promotion, recognition, and new responsibilities.</p> <p>13. Brokered opportunities: Professional development opportunities are routinely and proactively offered to members to assure their continued growth and vitality.</p> <p>14. Decentralized organization: Governance structures are flat and decentralized where participation of members is expected.</p> <p>15. Assertive participative governance: Clear and common goals, assertive and participative leadership where active participation of members is expected, and effective feedback systems are utilized.</p>	<p>1. Scholar: Highly regarded as a scholar; serves as a sponsor, mentor, and peer model for other group members.</p> <p>2. Research oriented: Possesses a “research orientation”; has internalized the group’s research-centered mission.</p> <p>3. Capably fulfills all critical leadership roles:</p> <ul style="list-style-type: none"> ● Manager of people and resources ● Fund-raiser ● Group advocate ● Keeps the group’s mission and shared goals visible to all members ● Attends to the many individual and institutional features that facilitate research productivity <p>4. Participative leader:</p> <ul style="list-style-type: none"> ● Uses an assertive, participative style of leadership ● Holds frequent meetings with clear objectives ● Creates formal mechanisms and sets expectations for all members to contribute to decision making ● Makes high-quality information readily available to the group ● Vests ownership of projects with members and values their ideas

more than females, but this difference was eliminated when the density of female faculty in lower ranks was taken into account. Thus, in the present study, we found no difference in productivity due to gender when rank is controlled.

3. Department type. Additionally, we found no difference in productivity due to department type (clinical versus basic science). Notably, the clinical departments have both MD and PhD faculty. The most research-productive faculty subgroup in this sample was PhDs in clinical departments.

Conversely, we found two demographic variables were significant predictors of research productivity:

1. **Appointment type.** We found a significant difference in faculty research productivity according to appointment type (tenure-track faculty were more research productive than were faculty on other appointments). This is consistent with previous studies.¹⁵
2. **Rank.** We found a significant difference in research productivity by rank (e.g., full professor, associate professor, and assistant professor). Because research

productivity is one of the major criteria for promotion, high research productivity in faculty of higher rank is understandable. Again, this finding is consistent with previous studies.^{7,16}

Predictors of faculty research productivity

What individual, institutional, and leadership variables best predict a faculty member's research productivity? We conducted a multiple logistic regression to summarize the relationship between a faculty member's level of research productivity and individual, institutional, and leadership qualities (see Table 1). The outcome variable was faculty who produced more than five articles in the last two years, called highly research productive, versus those who produced fewer, called moderately research productive. Demographic variables, except rank, were included in the regression (e.g., gender, age, time spent on various activities, degree, race). The regression found that data on nine questions resulted in correctly assigning 75% of the respondents to the categories of highly or moderately research productive.

Six of the nine variables in Table 1 were positively associated with research productivity, meaning that high faculty responses to these questions were associated with higher research productivity. The six variables were:

1. I would describe myself as being internally driven to conduct research.
2. On average, in 1999, how many hours each week were you involved in research?
3. I have a well-developed network of colleagues with whom I discuss research projects and education.
4. On average, in 1999, how many hours each week were you involved in administration?
5. I have been (or was when I was a junior faculty member) formally assigned an advisor or mentor within my academic department.
6. The number of faculty in my department is large enough to accomplish our goals in research.

Most of these variables intuitively make sense. The variable regarding spending a larger amount of time on administration may have emerged in the model because

Table 1
Logistic Regression of Characteristics Predicting Individual Research Productivity Based on a 2000 Survey, University of Minnesota Medical School*

Variable	Coefficient (β)	Standard error	Wald χ^2	p value	Odds ratio
Individual characteristic: motivation					
Internally driven to conduct research	1.21	.245	24.40	.000	3.35
Institutional characteristics					
(a) Sufficient work time					
Number of hours/week involved in research	.019	.009	4.57	.032	1.02
Number of hours/week involved in administration	.057	.017	11.01	.001	1.06
Number of hours/week involved in teaching	-.065	.019	11.04	.001	.977
(b) Size/experience/expertise					
Considers the number of faculty in the department large enough to achieve departmental research goals	.286	.113	6.37	.012	1.33
(c) Mentoring					
Has or has had a formally assigned mentor in the department	.631	.284	4.95	.026	1.88
(d) Culture					
Considers a large portion of the department faculty to be significant external grant-getters	-.422	.125	11.35	.001	.655
(e) Communication with professional network					
Has a well-developed network of external colleagues with whom one can discuss research projects and education	.516	.157	10.86	.001	1.68
Has a well-developed network of colleagues in the department with whom one can discuss research projects and education	-.294	.122	5.78	.016	.746

* The table is adapted from Bland et al.¹ Knowing the faculty members' ratings or information about these nine items resulted in correctly assigning 75% of the respondents to the categories of highly versus moderately research productive.

70% of our department heads fall into the category of highly research productive. These faculty members, all strong researchers, would also have listed large numbers of hours in administration. Also, our highly productive researchers often manage large grants, requiring them to spend time on such things as personnel, budget, and other administrative duties.

Three variables were negatively associated with research productivity, meaning that low faculty responses to these questions were associated with a high level of research productivity. These variables were:

1. A large portion of my academic department's faculty can be considered to be a significant external grant-getter.
2. On average, in 1999, how many hours each week were you involved in teaching?
3. I have a well-developed network of colleagues in the department with whom I discuss research projects and education.

These results suggest that having a network within the department is not necessary for research productivity, whereas having an external network is essential. This external network of highly productive researchers likely becomes the frame of reference for a highly productive researcher. Thus, it is possible that researchers then view their own department in comparison and see that it does not possess as large a number of significant grant-getters as does their external network. Having fewer hours in teaching reflects the reality of highly productive researchers committing more time to research compared with others.

Of course, we do not know if these variables "cause" high research productivity; we only know they are associated with high research productivity. However, the findings do suggest that these individual variables are ones to consider when trying to create and implement faculty development programs and other types of initiatives to facilitate research productivity.

What individual, institutional, and leadership variables best predict group (department) research productivity? Faculty do not work in isolation. The primary environment in which they work

is their department, and when research is the goal, they are advantaged to be in a department that is collectively research productive.^{7,17-21} To identify differences between highly research productive departments and moderately research productive departments, we ranked departments by their percentages of faculty considered to be highly research productive. Data analysis revealed a natural break in the data between 42% and 48% of the department's faculty; that is, there were no departments where 43-47% of the faculty were highly research productive. Thus, we defined departments as highly research productive if 48% or more of their faculty had published five or more articles in the last two years. Furthermore, we defined departments as moderately research productive if 42% or less of their faculty had published less than five articles in the past two years.

Interestingly, we found 11 of 23 departments (48%) were highly research productive; 56% of our faculty were in these departments. In fact, all but two of our large departments (i.e., 20 full-time faculty or more) were in the highly research productive group. Previous research found a positive association between size of department and level of department research productivity.^{8,19,21-24} In our study there is a small, nonsignificant relationship between department size and productivity ($r = .26$).

We performed a multiple logistic regression using all the questionnaire's items related to the department, with the dependent variable being moderate versus highly research productive department (see Table 2). Again, all demographic variables except rank were also included in the regression (e.g., gender, age, time spent on various activities, race). The regression model (Table 2) correctly assigned a faculty member 78% of the time to the correct level of department productivity.

Thus, we found a department with high research productivity in our school was one where the core missions of research and education were emphasized, the expectations to be productive in research and generate external research dollars was clear, a large portion of the faculty were grant-getters, there was good communication about issues, and there were nonmonetary mechanisms for rewarding

teaching. At the same time, we found a negative association with having a department head known best for his or her administration, where recognition and nonmonetary rewards were provided for administration, opinions were seriously considered by leadership when making important decisions, and more time was spent on teaching.

This regression revealed the important role of the department head. He or she keeps the core missions in front of faculty, makes the generation of dollars through research a high expectation, and assures communication. Similarly, department heads have a great deal to do with the number of hours faculty devote to teaching as well as other roles and what work is recognized nonmonetarily.

What individual, institutional, and leadership variables best predict a faculty member's satisfaction? To maintain high research productivity, an institution presumably must retain productive researchers and attract promising new faculty. To summarize the relationship between research-conducive characteristics and faculty members' satisfaction with their department, we performed a stepwise multiple regression analysis using as the outcome measure the response to the question: "If I were to select a faculty career again, I would choose to be: in my current department." Fifteen variables accounted for 53% of the variance in faculty's satisfaction with their department and are listed in Table 3.

Satisfaction with a department seems to be primarily associated with institutional and leadership variables rather than with an individual faculty's variables. Perceived support from the department head for both faculty's teaching and research efforts is particularly important, as is having one's opinions seriously considered and having opportunities to pursue research interests. Having capable colleagues is also important, as is reflected in having recruitment strategies to attract talent, having a sufficient number of faculty, and having a network of faculty.

When a department expects faculty to generate as much revenue as possible from nonteaching or nonresearch activities such as patient care, or faculty to spend more hours on education and research, faculty satisfaction is significantly impacted. The negative correlation with more research hours may be a result of

Table 2

Logistic Regression of Characteristics Predicting Department Research Productivity Based on a 2000 Survey, University of Minnesota Medical School*

Variable	Coefficient (β)	Standard error	Wald χ^2	p value	Odds ratio
(Constant)	-3.748				
Institutional characteristics					
(a) Resources On the average, in 1999, how many hours each week were you involved in education?	-.052	.017	9.030	.003	.95
(b) Rewards My department has systematic and fair mechanisms for nonmonetarily recognizing and celebrating achievements (e.g., putting in department newsletter, "toasting" at faculty meetings) in education.	.598	.214	7.767	.005	1.818
My department has systematic and fair mechanisms for nonmonetarily recognizing and celebrating achievements (e.g., putting in department newsletter, "toasting" at faculty meetings) in administration.	-.384	.216	3.147	.076	.681
(c) Clear coordinating goals My department leadership keeps us on track by clearly emphasizing our core missions of education and research.	.463	.180	6.630	.010	1.589
(d) Size/experience/expertise The number of faculty in my department is large enough to accomplish our goals in research.	.273	.117	5.466	.019	1.314
(e) Culture A large portion of my academic department's faculty can be considered to be significant external grant "getters."	.458	.146	9.861	.002	1.582
(f) Communication My department has a communication system that allows me to be adequately informed in a timely fashion about major issues, important events, and upcoming concerns.	.384	.152	6.411	.011	1.468
(g) Research emphasis There is a high expectation in my department for faculty to generate as much revenues as possible via nonteaching or research activities (e.g., patient care).	.313	.129	5.906	.015	1.368
There is a high expectation in my department for faculty to be productive in research (e.g., produce peer-reviewed articles, develop innovations that can be patented or copyrighted).	.440	.157	7.804	.005	1.553
(h) Communication with professional network I have a well-developed network of colleagues with whom I discuss research projects and education within my academic department.	-.312	.134	5.448	.020	.732
(i) Assertive—participative governance My opinions are seriously considered by the leadership in the department when making important decisions.	-.298	.141	4.455	.035	.742
Leadership characteristic: uses assertive—participative					
My department head is highly regarded for his/her administration.	-.509	.155	10.790	.001	.601

* The model shown correctly assigns a faculty member 78% of the time.

responses from basic scientists who, on average in this study, were less satisfied than were clinical faculty and who spent more time on research (32 versus 18 hours per week).

How well does the Bland et al. (2002) model explain research productivity?

The Bland et al. (2002) model is designed to explain faculty research productivity on two levels. First, it suggests there are specific individual, institutional, and

leadership characteristics associated with faculty research productivity. Second, it suggests there is a hierarchical order to these three groups of behaviors. That is, the individual characteristics are essential, but they have more or less power in assuring research productivity depending on how research conducive the institution is. Finally, the impact of the institution is mediated by the qualities and style of the leader.

The regression that predicted an individual's research productivity (see Table 1) contains one of the individual characteristics (motivation) and eight of the institutional characteristics in the Bland et al. (2002) model. It is not surprising that the regression did not include additional individual characteristics, as has been the case with many other research studies on faculty research productivity. Recall that nearly all the faculty in this study pos-

Table 3

Stepwise Regression of Characteristics Predicting Faculty Satisfaction (i.e., "I would select a faculty career again in my current department.") Based on a 2000 Survey, University of Minnesota Medical School*

Variable	Coefficient (β)	Standard error	t	p Value	Cumulative R ²	Change in R ²
(Constant)	-1.061					
Institutional characteristics						
(a) Positive group climate						
My department head is very supportive of my efforts in teaching.	.185	.066	2.804	.005	.297	.297
My department head is very supportive of my efforts in research.	.180	.068	2.639	.009	.402	.024
(b) Recruitment and selection						
Effective recruitment strategies are in place for attracting the best talent in priority areas in my department.	.136	.057	2.395	.017	.378	.081
(c) Size/age/diversity						
The number of faculty in my department is large enough to accomplish our goals in research.	.112	.046	2.408	.017	.446	.013
(d) Sufficient work time						
On average, in 1999, how many hours each week were you involved in:						
Research, education, direct patient care, administration, university service, outreach, and other faculty work in total?	.0138	.005	2.896	.004	.433	.012
Administration?	.0117	.006	1.909	.057	.518	.006
Education?	-.0152	.007	-2.242	.026	.499	.007
Research?	-.0139	.004	-3.513	.001	.421	.190
(e) Rewards						
When money is available, my department has systematic and fair mechanisms for monetarily recognizing and rewarding achievements in administration.	-.122	.059	-2.070	.039	.512	.006
(f) Culture						
There is a high expectation in my department for faculty to provide quality patient care.	.151	.059	2.567	.011	.492	.011
There is a high expectation in my department for faculty to generate as much revenue as possible via nonteaching or research activities (e.g., patient care).	-.111	.053	-2.069	.040	.525	.008
I have excellent opportunities here to pursue my interests in research.	.132	.056	2.361	.019	.470	.014
(g) Communication with professional network						
I have a well-developed network of colleagues with whom I discuss research projects and education within my academic department.	.0991	.050	1.994	.047	.506	.006
Leadership characteristics						
(a) Participative leader						
My opinions are routinely solicited for important division and department decisions.	.0987	.053	1.861	.064	.482	.011
(b) Capably fulfills all critical leadership roles						
My department head is highly regarded for his/her administration.	.117	.052	2.226	.027	.456	.010

* Results account for 53% of variance in faculty satisfaction.

sessed the individual characteristics associated with research productivity, such as content knowledge, advanced research skills, and scholarly work habits. Thus, there was little variance on these characteristics. Being driven to conduct research, labeled "motivation" in the

model, was also consistently high for all faculty studied (the modal response was four on a five-point scale where five was high). However, the variance on this item was striking: nearly all the highly productive faculty rated this item five. In short, they were *very* driven to conduct research.

The other eight items that predicted individual research productivity picked up many of the institutional characteristics in the Bland et al. (2002) model, such as faculty having a formally assigned mentor, a well-developed network of colleagues outside the department with whom to dis-

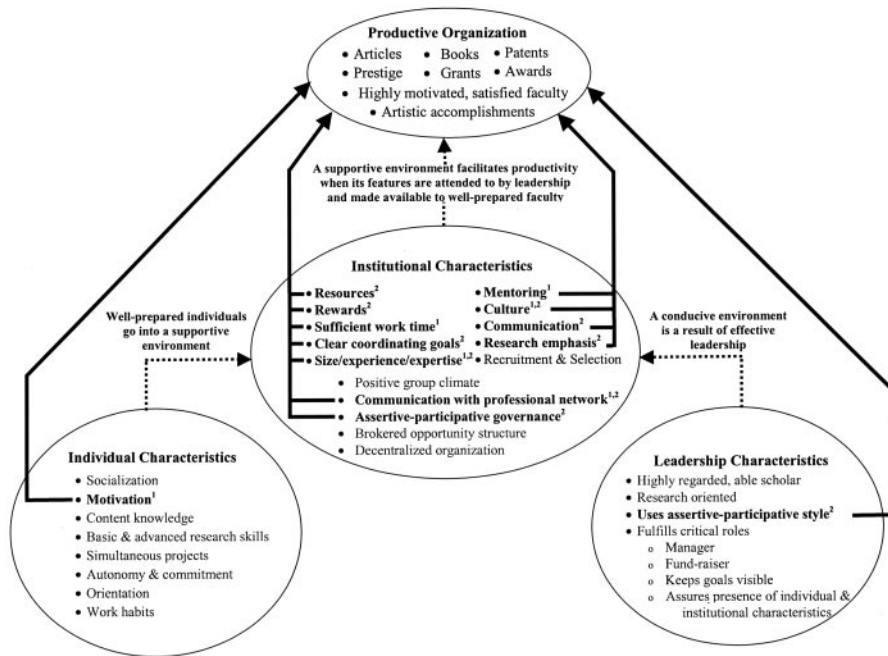


Figure 2 Model of individual, institutional, and leadership characteristics (in bold) predicting individual and department research productivity based on combined results from regressions (¹see Table 2, “Logistic Regression of Characteristics Predicting Individual Research Productivity,” for further clarification; ²see Table 3, “Logistic Regression of Characteristics Predicting Department Research Productivity,” for further clarification).

cuss research and education, time to do research, less time on teaching, enough faculty to achieve goals, and a less-developed network of department colleagues.

Leadership characteristics were not identified by this regression; however, it is unlikely that the institutional characteristics would be present in the regression without a leader who possessed the characteristics in the model.

If a model for faculty research productivity was based solely on this regression, it would use the characteristics noted with a superscript of “1” in Figure 2. But, a model using only these characteristics would not be very useful and would likely be incomplete because most researchers conduct their work as members of a larger organization. Further, most of the predictors in Figure 2 are not controlled by the individual but rather are a function of the organization in which they work. In addition, these features are highly dependent on the group in which the researcher works; for example, are there enough faculty to do the work and an adequate number of senior faculty who can be mentors? For that reason, to understand what facilitates individual research productivity one also needs to look at features of the department that facilitate group productivity.

Our second regression (see Table 2) did just that. This regression picks up many of the institutional and leadership characteristics found in the Bland et al. (2002) model. If a model were built on just this regression, it would include the characteristics noted with a superscript of “2” in Figure 2.

Together, these two regressions and two models confirm a large number of the characteristics suggested in the Bland et al. (2002) model (see Figure 2). Recall that the Bland et al. (2002) model was developed via a synthesis of studies on research productivity that varied widely in their study designs and populations. It is reassuring that so many of the features drawn from such a wide range of studies are confirmed as essential even in a very specific type of institution (i.e., a medical school in a research-oriented university).

We conducted a confirmatory factor analysis to affirm that the variables we observed do cluster into our three theoretical groupings. Thus, for this analysis, we used only the questions related to research. The overall fit of the model was good. All of our variables loaded significantly on their theoretical factors, with two exceptions. Significant factor loadings ranged from .14 (“mentoring,” a

dichotomous variable) to .79. Bentler’s Comparative Fit Index was .96, and the more conservative Normed Fit Index was .91 (for which, in general, any amount over .90 is considered good).^{25,26} The root mean square error of approximation (RMSEA) was .056 (an RMSEA under .06 is considered good).²⁷

As mentioned, two characteristics—having a well-developed external network and number of hours spent on research—did not load significantly on the institutional factor, as we had expected. Rather, these loaded significantly on the individual factor (Table 4 displays the loadings on both the individual and institutional factors). In the evolution of the Bland et al. (2002) model, it has been noted that some of the characteristics associated with research productivity would actually be linked to two different groupings. For example, “hours spent on research” is likely a function of both the institution and individual and would, therefore, fit in both factors. Thus, as the model has evolved, some characteristics have moved between groupings. In addition, we found that two other items loaded significantly on two factors (the predicted factor and one other). “Department commitment,” and “communication with colleagues” loaded on both the individual and institutional groupings.

These empirical results suggest that “external network” and “number of hours spent on research” should be moved in the model to the individual factor and that “department commitment” and “conversations with colleagues” should be placed in two groupings, although there is an attractive simplicity to placing each characteristic in its dominant cluster. Before moving these characteristics, it is important to consider the context of this study. At the University of Minnesota Medical School—Twin Cities, there is no written or unwritten policy as to the amount of time faculty are expected to devote to research. Rather, each faculty member negotiates research time with the person to whom they report, and the agreed upon time is largely dependent on the amount of external research dollars the faculty member has acquired. Similarly, opportunities to network with colleagues are largely a function of the travel dollars faculty members have as a result of grants. Thus, at our school, variations in time spent on research and networking with external colleagues are largely deter-

Table 4

Factor Analysis of Survey Questions and Bland's Theoretical Groupings Based on a 2000 Survey, University of Minnesota Medical School*

	Bland et al. (2002) ¹ model characteristics		
	Individual	Institutional	Leader
Individual characteristics			
(a) Motivation			
I would describe myself as being internally driven to conduct research.	.68		
(b) Content knowledge			
I stay very "up-to-date" on the current literature in my research interest area(s).	.53		
(c) Basic and advanced research skills			
For the following items, indicate if you believe you are currently up-to-date in:			
Research skills for your area (e.g., statistics, research design, data collection, laboratory procedure)	.70		
Grant-getting skills for your area (e.g., identifying funding sources, preparing grants, using research reviews)	.65		
Computer skills (e.g., word processing, data management and analysis, presentation software, e-mail)	.38		
Writing skills (e.g., identifying appropriate outlet/audience, constructing concise/persuasive text)	.43		
(d) Autonomy and commitment			
I am highly committed to contributing to the success of my:			
Career	.44		
Department	.20	.21	
School	.27		
University	.29		
Discipline	.31		
If I were to select a faculty career again, I would choose to be in my current discipline.	.37		
If I were to select a career again, I would not choose a faculty career.	.39		
Institutional characteristics			
(a) Recruitment and selection			
Effective recruitment strategies are in place for attracting the best talent in priority areas in my department.			.71
(b) Clear coordinating goals			
My department has a commonly held vision for what we want to look like in the next five years.			.61
It is clear to me how my work and goals are or can be related to the department vision.			.62
I have confidence in the current direction in which my department is heading.			.75
(c) Research emphasis			
There is high expectation in my department for faculty to be productive in research.			.31
There is a high expectation in my department to conduct research that is externally funded.			.19
The reward system in the department matches the departmental vision and goals.			.54
The priorities in the department (e.g., money allocation, new hires, cuts) match the stated vision.			.52
(d) Culture			
I have excellent opportunities here to pursue my interests in research.			.47
A large portion of my academic department's faculty can be considered to be productive in research (e.g., produce peer-reviewed articles, develop innovations that can be patented or copyrighted).			.39
A large portion of my academic department's faculty can be considered to be significant external grant "getters."			.33
(e) Size/experience/expertise			
The number of faculty in my department is large enough to accomplish our goals in research.			.29
(f) Positive group climate			
If I were to select a faculty career again, I would choose to be in my current department.			.56
(g) Mentoring			
I have been, or had been, formally assigned an advisor or mentor within my academic department.			.14
I have (or had when I was a junior faculty member) an "unassigned" mentor(s) either in this department or in other departments/schools/organizations who provides me with valuable guidance in research.			.20
I get constructive feedback, guidance, and suggestions from my department colleagues that help me perform my best.			.48
I fully understand the research, teaching, and patient care expectations for promotion in the appointment I hold.			.34
I have a clear picture of where I want to be in my academic career in five to seven years.			.25
I have a well-defined plan for achieving my academic career goals.			.39
(h) Communication with professional network			
I have a well-developed network of colleagues with whom I discuss research projects and education:			
Within my academic department.			.53
Outside my department/within university.			.37
Outside the university.	.49		.06†
At least weekly, I have substantive, uninterrupted conversations with important colleagues about research and education:			
In my department.			.57
In my school.			.46

(Table continues)

Table 4
(Continued)

	Bland et al. (2002) ¹ model characteristics		
	Individual	Institutional	Leader
In my university.			.36
In my discipline.	.33		.22
(i) Resources			
I have access to adequate resources such as secretarial support, research/teaching assistants, computers, library materials, data analyses, technical support, nursing/clerical staff support, etc., to conduct my research projects.			.47
My academic department provides me with, or I have from external or other sources, adequate support to travel to research-based conferences.			.35
I have adequate space to conduct my research.			.24
I have space that is well equipped for me to conduct my research.			.35
The skills, expertise, and experience of faculty in my department are appropriate to accomplish our research goals.			.42
I feel appreciated and valued by my local colleagues (department/school/university) for my work in research.			.53
(j) Sufficient work time			
I have adequate time to conduct research projects.			.28
I have a system that allows me to protect periods of uninterrupted time to address research activities.			.33
I have a high degree of input into how I wish to spend my time within each of my faculty roles.			.51
On average, in 1999, how many hours each week were you involved in research?	.43		.01†
(k) Communication			
My department has a communications system that allows me to be adequately informed in a timely fashion about major issues, important events, and upcoming concerns.			.62
(l) Rewards			
My department has systematic and fair mechanisms for <u>nonmonetarily</u> recognizing and celebrating achievements (e.g., putting in the department newsletter, "toasting" at faculty meetings) in research.			.59
When money is available, my department has systematic and fair mechanisms for <u>monetarily</u> recognizing and rewarding achievements in research.			.58
As compared to others <u>at this school</u> , my compensation (i.e., salary and fringe benefits) is fair for the work I do.			.38
(m) Brokered opportunities			
My department leadership (e.g., department head, senior faculty) actively nominates the following individuals for awards, honors, and growth opportunities such as fellowships or new positions:			
New faculty members			.60
Midcareer faculty members			.59
Senior faculty members			.58
Women faculty members			.59
(n) Assertive participative governance			
The vision of the department is kept visible by my department senior faculty.			.60
My department leadership makes clear the expected ethical standards and practices in research.			.66
Leadership characteristics			
(a) Scholar			
My department head is highly regarded for his/her research.			.49
My division leader is highly regarded for his/her research.			.40
(b) Research oriented			
My department head is very supportive of my efforts in research.			.67
(c) Capably fulfills all critical leadership roles			
The vision of the department is kept visible by my department head.			.78
I get constructive feedback, guidance, and suggestions from my department head that help me perform my best.			.79
(d) Participative leader			
My opinions are <u>routinely solicited</u> for important division and department decisions. [‡]			.72
My opinions are <u>seriously considered</u> by leadership in the department when making important decisions. [‡]			.73
It is <u>expected</u> that faculty will meaningfully and actively contribute to important decisions in my department.			.77

* Normal theory weighted least-squares $\chi^2 = 4055.47$ ($p < .001$); root mean square error of approximation = .056; normed fit index = .91; comparative fit index = .96.

† This item did not load significantly on the institutional factor as predicted. Rather the significant loading was on the individual factor. The institutional loading is presented just for information.

‡ In this factor analysis, these survey questions were categorized as leadership characteristics. In reality, having a leader with these qualities facilitates participative governance (an institutional characteristic).

mined at the individual level, not the institutional level. However, many schools have at least a minimum percentage of time that all faculty are expected to de-

vote to research and a minimum amount of travel dollars for each faculty to attend professional conferences. If that is the case, the institution creates the opportunity for net-

working with colleagues and determines the amount of time faculty can spend on research. Had our survey included faculty from different schools, we believe these two

characteristics would have loaded on the institutional grouping. Therefore, we are not convinced that the Bland et al. (2002) model should be modified based on the results of this one study.

Further, the Bland et al. (2002) model suggests the characteristics associated with research productivity cluster into three unique groupings: individual, leadership, and institutional. To assess this, we looked at the correlations between them. We found that the correlation of the individual characteristics with leadership characteristics was $r = .21$; the correlation of individual characteristics with institutional characteristics was $r = .39$; and the correlation of leadership characteristics with institutional characteristics was $r = .95$. So, the clusters appear unique except for the last correlation of institutional and leadership characteristics. However, this finding is likely an artifact of the study data (the respondents were from the same institution and school). There could be no institutional variability except on the departmental level. Thus, in this study, the leadership variable was highly constrained. Because leadership at the dean's level and above was fixed, we could reflect only upon leadership differences at the departmental level and below.

To confirm that institutional characteristics and leadership characteristics are truly different, even under these conditions, we ran a second factor analysis combining the leadership and institutional factors. This second analysis, the two-factor model being a subset of the first (the three-factor model), did not fit the data as well ($\chi^2(2) = 133.19$; $p < .001$). This confirmed that the leadership and institutional factors are statistically different, even though they are highly correlated in this situation. And, it confirmed that the three-factor model is the best fit with the data.

Finally, we turn to the hierarchical order of these three groups suggested by the Bland et al. (2002) model. Unfortunately, the productivity measure in this study is a simple dichotomous variable and is inadequate for a path analysis to assess, statistically, the hierarchy of these groupings. So, with these data, we are unable to either confirm or disprove the hierarchical assertion in the Bland et al. (2002) model.

How is this information practically applied in facilitating individual or group

research productivity? To use this information to facilitate research for one's self, for another individual faculty member, or for a group or department, one needs to combine the findings. An individual cannot be productive in isolation. On the other hand, one cannot have a research-productive group without having faculty members who are individually productive. Thus, we return to the Bland et al. (2002) model. It accurately contains the characteristics associated with research productivity. However, the lines showing the characteristics' direction of influence do not completely reflect the regression results (see Figure 1). For example, we did not confirm that motivation for research, an individual characteristic, affects research productivity only if it is coupled with essential institutional characteristics. Yet, we know that motivation cannot result in research productivity without the many supportive characteristics found in the institution. The Bland et al. (2002) model integrates the statistical findings from the two regressions with our conceptual understandings about research to provide an integrated picture that can guide those wishing to increase faculty research productivity.

Conclusions

As previously mentioned, a significant amount of disparate research has been conducted on variables, especially at the individual faculty level, to determine what leads to research productivity. Drawing from this literature, Bland et al. (2002) proposed a model that identified a number of important factors at the individual, institutional, and leadership levels. We sought to confirm how this broad set of individual, institutional, and leadership variables operate together to impact faculty research productivity within the context of a single research university.

The separate analyses of the characteristics associated with individual research productivity, group productivity, and faculty satisfaction not only identified the characteristics that predict these outcomes, but also demonstrated how separate these outcomes are. Quite different characteristics are associated with each of these outcomes.

With regard to individual faculty's research productivity, the predicting characteristics are very similar to what other

studies have found. In some ways this is surprising, given that this study was done in a highly research-oriented institution with quite established faculty. However, it seems that even in this type of institution, when individual faculty's research productivity is the goal, nothing substitutes for recruiting faculty with a passion for research, providing them with formal mentoring programs, facilitating their networks, and providing time for them to do research. It also confirms that an individual's research productivity is influenced by a combination of individual characteristics and institutional characteristics. We would also contend that this confirms the importance of research-oriented leaders. Even though leadership factors did not specifically load, the institutional features that did are primarily in the hands of administrators. Also, the leadership features in the model are highly correlated with the institutional features.

The characteristics that facilitate group productivity closely mirror the institutional and leadership characteristics in the model. Although individual characteristics did not load on this regression, this does not suggest that these are unimportant to departmental research productivity. In fact, individual characteristics are the foundation of and prerequisite for many of the institutional variables including culture; positive group climate; size, experience, and expertise; and mentoring. Nevertheless, institutions that want most of their faculty, instead of a few stars, to be highly research productive should emphasize institutional and leadership characteristics such as clear coordinating goals, research emphasis, communication, and assertive-participative governance.

Taken together, these separate analyses reinforce the perception that a highly research productive organization is indeed a function of the integration and interplay of the individual and institutional features. Furthermore, the successful synthesis of these features is heavily dependent on effective leaders. It is this combination that the Bland et al. (2002) model depicts.

References

- 1 Bland CJ, Seaquist E, Pacala JT, Center B, Finstad D. One school's strategy to assess and improve the vitality of its faculty. *Acad Med.* 2002;77:368-76.

- 2 Bland CJ, Schmitz CC. Characteristics of the successful researcher and implications for faculty development. *J Med Educ.* 1986;61:22–31.
- 3 Bland CJ, Ruffin MT, IV. Characteristics of a productive research environment: literature review. *Acad Med.* 1992;67:385–97.
- 4 Bland CJ, Bergquist WH. The Vitality Of Senior Faculty Members: Snow On The Roof—Fire In The Furnace. ASHE-ERIC Higher Education Report, 25(7). Washington, DC: George Washington University, Graduate School of Education and Human Development, 1997.
- 5 Bland CJ, Weber-Main AM, Finstad D, Lund SM. Research Productive Departments: Strategies from Departments that Excel. Bolton, MA: Anker Publishing Co., 2005.
- 6 Finkelstein MJ. The American Academic Profession: A Synthesis of Social Scientific Inquiry since World War II. Columbus: Ohio State University Press, 1984.
- 7 Creswell JW. Faculty Research Performance: Lessons from the Sciences and Social Sciences. Washington, DC: Association for the Study of Higher Education, 1985.
- 8 Dundar H, Lewis DR. Determinants of research productivity in higher education. *Res Higher Educ.* 1998;39:607–31.
- 9 Teodorescu D. Correlates of faculty publication productivity: a cross-national analysis. *Higher Educ.* 2000;39:201–22.
- 10 Brocato JJ. The research productivity of family medicine department faculty: a national study [dissertation]. Michigan State University, 2001.
- 11 Russell SH, Cox RC, Boismier JM. A Descriptive Report of Academic Departments in Higher Education Institutions. 1988 National Survey Of Postsecondary Faculty (NSOPF-88). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement, 1990.
- 12 Blackburn RT, Lawrence JH. Aging and the quality of faculty job performance. *Rev Educ Res.* 1986;56:265–90.
- 13 Cole JR, Zuckerman H. Marriage, motherhood, and research performance in science. In: Zuckerman H, Cole JR, Bruer JT (eds). *Outer Circle: Women in the Scientific Community.* New York: W. W. Norton & Company, 1991:157–70.
- 14 Sax LJ, Hagedorn LS, Arredondo M, DiCrisi FA III. Faculty research productivity: exploring the role of gender and family-related factors. *Res Higher Educ.* 2002;43:423–46.
- 15 Bland CJ, Finstad D, Center B, Staples J. The impact of appointment type and faculty role differentiation on the productivity, satisfaction, and commitment of full-time faculty in research/doctoral institutions. *J Higher Educ.* [submitted].
- 16 Creswell JW, Bean JP. Research output, socialization, and the Biglan model. *Res Higher Educ.* 1996;15:69–89.
- 17 Bland CJ, Schmitz CC. An overview of research on faculty and institutional vitality. In: Schuster JH, Wheeler DW (eds). *Enhancing Faculty Careers: Strategies for Development and Renewal.* San Francisco: Jossey-Bass, 1990:41–61.
- 18 Pelz DC, Andrews FM. *Scientists in Organizations: Productive Climates for Research and Development.* New York: John Wiley & Sons, 1966.
- 19 Pineau C, Levy-Leboyer C. Managerial and organizational determinants of efficiency in biomedical research teams. In: Epton SR, Payne RL, Pearson AW (eds). *Managing Interdisciplinary Research.* New York: John Wiley & Sons, 1983:141–63.
- 20 Andrews FM (ed). *Scientific Productivity: The Effectiveness of Research Groups in Six Countries.* Cambridge: Cambridge University Press, 1979.
- 21 Blackburn RT, Behymer CE, Hall DE. Research note: correlates of faculty publications. *Sociol Educ.* 1978;51:132–41.
- 22 Baird L. What characterizes a productive research department? *Res Higher Educ.* 1986; 25:211–25.
- 23 Johnston R. Effects of resource concentration on research performance. *Higher Educ.* 1994; 28:25–37.
- 24 Jordan JM, Meador M, Walters SK. Effects of department size and organization on the research productivity of academic economists. *Econ Educ Rev.* 1988;7:251–5.
- 25 Bentler PM, Bonnett DG. Significance tests and goodness-of-fit in the analysis of covariance structures. *Psychol Bull.* 1980;88:588–606.
- 26 Garson GD. Structural equation modeling (<http://www2.chass.ncsu.edu/garson/pa765>). Accessed 12 February 2003. PA 765, Statnotes: An Online Textbook. College of Humanities and Social Sciences, North Carolina State University, Raleigh, NC.
- 27 Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling.* 1999;6:1–55.